



END-TO-END SOLUTIONS FOR THE ENERGY TRANSITION

Consulting, engineering, construction management and field services for a more sustainable, reliable, and resilient grid



GRID MODERNIZATION



From aging infrastructure to a rapidly changing energy mix incorporating renewables and distributed energy resources, major advancements in technology, shifting customer demands and evolving policy, utilities today are faced with unprecedented challenges.

Implementing significant upgrades and modernization initiatives are essential to maintain reliability, build resiliency and bolster the safety and security of the electric grid both now and for the future. Modernization programs, however, can be a significant undertaking that requires detailed planning and complex execution.

At TRC, our advisors, designers and engineers have the expertise and experience to advance your grid modernization projects from start to finish. As a trusted partner, we work with you to bring automation, control, visibility and flexibility to your assets, systems and operations.



OUR SOLUTIONS INCLUDE:

Distribution Operational Technologies (OT)

- Solid reputation for delivering OT expertise and solutions (SCADA/DMS/OMS)
- 120+ SMEs with 20+ years experience on average
- Advisory services: market surveys, business cases, requirements, use cases, RFPs and vendor selection services
- Implementation services: ranging from on-demand expertise to complete implementation teams embedded within client's organization
- Project management, technical leadership and specialized engineering services (architecture, displays and data model management, RTU communications, infrastructure, deployment and cutover)
- Maintenance support of large-scale OT systems across various vendor platforms

Advanced Metering Infrastructure (AMI)

- Architecture, design and operations consulting for AMI/MDM
- Enhanced use cases for reliability/resiliency and added customer value
- Leverage and integrate data to increase operational efficiency and improve decision making

Protection and Controls Design and Engineering

- New installations and additions/modifications to existing stations and systems
- Standards development
- Automation, including IEC-61850
- Relay cabinet design, application analysis and settings calculations
- NERC compliance consulting
- Testing and commissioning

System Protection Engineering and Distribution Automation

- Conceptual design through final commissioning
- Programmatic approach integrating equipment and device standardization, template development, process optimization and deployment monitoring
- Studies, calculations, relay settings, models, and compliance

Distribution Planning, Design and Engineering

- Overhead and underground design
- Pole loading and structural analysis, joint use management
- Line relocation and reconductoring
- Storm assessment, hardening and recovery
- System studies and reliability planning

Geospatial Solutions (GIS)

- Data assessments and technical roadmaps, to implementation, data validation and modeling
- System design and strategic planning
- Distribution integrity
- Standardized, verifiable and complete systems that are easy to maintain and accessible to a whole organization

Telecommunications

- Planning, design and field solutions supporting network development from concept through commissioning
- Master planning studies, smart grid planning and inter/intra substation communications
- Microwave, wireless and fiber system design
- FCC licensing and compliance
- Performance testing

DECARBONIZATION



The impacts of climate change are visible across every community- increasing wildfires, more severe weather, loss of power during frequent storms. As the world takes steps to tackle this unprecedented challenge, rigorous carbon reduction strategies are imperative.

Decarbonization is accelerating at all levels globally. As a leading consulting firm committed to this transformation, TRC provides environmentally focused and digitally powered solutions to reduce emissions.

We partner with government agencies, utilities, and businesses from initial planning through design and execution of decarbonization programs. From the electrification of vehicles and buildings to energy efficiency and renewables, we are leaders in the movement towards a net-zero energy future.



OUR SOLUTIONS INCLUDE:

Decarbonization Strategy

- Objectives evaluation, pathways identification, technology assessment
- Roadmap development and modeling aligned with investment criteria and value creation opportunities
- Feasibility studies, fatal flaw analysis and front-end engineering design studies
- Project implementation, verification and reporting successes

Power System Studies

- Interconnection feasibility
- System planning reliability assessments
- System impact, analysis and modeling for steady state, dynamic and short-circuit for all voltage levels
- System protection studies, calculations, relay settings models and compliance support

Integrated Renewable Energy Development

- Integrated environmental, engineering and construction solutions for optimal project efficiency and accountability
- Site selection and evaluation
- Environmental planning and permitting
- Electrical and civil engineering and design
- Procurement and construction management
- Due diligence and transaction support

Battery Energy Storage Systems

- Business case strategy through design and build both behind and in-front of the meter
- Owner's engineering, customer program design/implementation and administration
- Site design and permitting, system studies, automation and controls engineering, civil design, construction management, testing and commissioning and interconnection

Energy Efficiency

- Award-winning energy conservation programs for some of the largest utilities, agencies and power authorities in North America
- Demonstration pilots to whole-portfolio implementation
- Program management from conception and research, to planning, design, implementation, customer engagement, engineering support, evaluation and continuous improvement.

Building Energy Efficiency

- Advanced building code
- Large scale energy efficiency programs for multifamily properties
- Research and technology commercialization
- Lighting studies, demonstration projects and program implementation

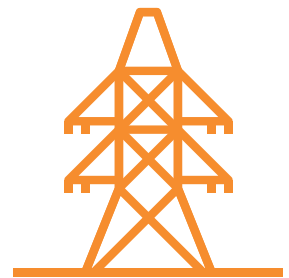
GRID RESILIENCY



Our power system today faces an ongoing risk of serious damage from threats including naturally occurring climate or weather-related disasters, accidents and deliberate harm. The growing intensity and frequency of severely disruptive events has made resiliency a top priority for utilities, regulators and customers

Whether undertaking projects to better withstand and recover from severe threat impacts or streamline operational data to manage distributed resources connecting to the grid, you need specialized expertise and manpower to plan and implement system enhancements.

TRC has been a trusted partner to the utility industry for over 50 years, helping to advance a reliable, responsive and resilient grid. Our integrated power delivery engineering and digital grid solutions help bridge the gap from current capabilities to future goals. We take a custom approach, based on your unique needs, helping simplify your operational processes and achieve cost effective, efficient grid modernization results that improve reliability for your customers.



OUR SOLUTIONS INCLUDE:

Distributed Energy Resources Integration and Management

- Research, strategy and business case development
- Use case analysis and technical assessments
- Functional and technical solutions design
- System vendor evaluation and technology procurement
- Solutions design, architecture and implementation

Transmission Engineering

- Overhead and underground line design
- Line rating, re-rating and upgrading
- NERC compliance
- Routing, siting, and right of way management
- Design alternatives and standards development
- Program and project management
- LineHub® digital design and engineering data management system

Substations

- AIS and GIS substations (2.3kV – 765kV)
- Engineering, procurement and construction
- Project management
- Construction management
- Integrated Design and construction (BIM, 3D, 4D, 5D & 6D)
- System Protection and control
- Automation and Integration
- Staff Augmentation

Digital Substations and High-tech Automation

- IEC 61850 engineering, from concept to completion
- Protection and control, system protection and automation-integration design
- Application development and testing
- Detailed documentation and standards development
- Settings and calculations
- Testing and commissioning

Compliance and Studies

- System planning and reliability risk assessments
- Standards tracking
- Audit evaluation, mitigation planning and compliance improvement
- Distributed generation and transmission planning studies
- System impact, power flow, short circuit and stability studies
- Asset optimization strategy
- Portfolio management

Storm Response Power Restoration

- Planning, damage assessment, engineering design and program management for emergency situations
- Public outreach and leadership for mutual assistance responses
- Facility restoration and circuit design improvements
- Construction and restoration crew management
- Hazardous clean-ups
- Digital transfer of field condition notes and records updates

Energy Management Systems (SCADA/EMS)

- Solid reputation for delivery of electricity transmission solutions (SCADA/EMS)
- Advisory services: market surveys, business cases, requirements, use cases, RFPs and vendor selection services
- Implementation services from on-demand expertise to complete embedded implementation teams
- Project management, technical leadership and specialized engineering services (architecture, displays and data model management, RTU communications, infrastructure, deployment and cutover)
- Maintenance support of large-scale OT systems across various vendor platforms

ASSET MANAGEMENT



The utility industry today faces many challenges when it comes to managing its aging infrastructure in an increasingly complex interdependent environment. Traditional asset management practices are no longer a viable solution to address the growing customer expectations for power quality and reliability. Effective asset management strategies that leverage new technologies and best engineering practices are key to optimizing critical operational functions and making better decisions for your business and customers.

Asset management programs and technologies help utilities better track the performance of critical infrastructure by providing visibility into age, usage, and maintenance to minimize the risk of equipment failure and maximize reliability for customers.

TRC delivers comprehensive asset management solutions from advanced data analytics to condition monitoring, mapping optimal rights of way, controlling dangerous vegetation and streamlining pole attachments, our robust asset management services can help you avoid outages, extend equipment lifespan, reduce operational costs and improve safety.



OUR SOLUTIONS INCLUDE:

Advanced Analytics and Artificial Intelligence

- Use case development
- Technology and data strategy
- Operational efficiency
- Data integration

Grid Hardening

- Assessment and feasibility planning
- System evaluation, outage analysis and risk modeling
- Design, implementation, and owner's engineering services
- Grid communications/sensor deployment, data reporting and data governance
- Microgrid, ADMS and DERMS programs
- Physical and cyber security

Aging T&D Infrastructure

- LineHub® digital design and engineering data management system
- Line rebuilds and uprating
- New transmission and fiber-optic communications designs
- Overhead and underground line design
- High voltage line design to 765 kV and HVDC
- Planning studies, land acquisition/management, routing and permitting
- Civil, structural and electrical engineering
- NERC compliance
- Line reliability and failure analysis
- Construction and program management

Joint Use Services

- Contracting and administrative services
- Make ready engineering and remediation
- Attachment request processing and notifications
- Pole attachment audits and inventories
- NESC safety audits and remediation
- Pole loading/structural analysis and clearance
- Pole ownership surveys and determination
- Standards and rate development
- Utility construction coordination and inspection
- Training, regulatory and litigation support

Vegetation Management

- Assessment, planning and program development including integrated vegetation management
- Digital solutions and technology integration
- Field surveys, safety and operations including GIS, spatial analysis and data collection
- Environmental and cultural permitting and monitoring
- Registered foresters and arborists

Testing and Commissioning

- Startup and commissioning of new equipment and systems (greenfield and energized sites)
- Troubleshooting, analysis and evaluation of in-service equipment and systems
- Protective relay testing
- High voltage apparatus testing
- Outage and energization planning
- Oversight and supervision
- Customized training programs

GRID SECURITY & RELIABILITY



Now more than ever, today's power grid is vulnerable to disruption. From the impacts of severe weather to man-made threats and attacks, ensuring the security and reliability of your assets and systems is critical to maintaining safe, continuous power and operations for your customers and communities.

Whether security breaches have occurred, or regulatory compliance is requiring your facility to step up security, or you want to be ahead of the curve with regards to protecting your people, systems and assets, TRC is your trusted advisor every step of the way.

TRC goes beyond just a simple checklist approach by using seasoned teams of experts to fit a solution to your needs. Our holistic approach includes the review of policies and procedures, the development and implementation of hardening and operational security measures and training recommendations.

With a clear vision and deep understanding of our clients' distributed operations and specialized network configurations, TRC develops and deploys strong yet flexible security programs that balance the fundamental elements of Risk Management, Operational Policies, System Hardening and Resiliency.



OUR SOLUTIONS INCLUDE:

Grid Hardening

- Assessment and feasibility planning
- System evaluation, outage analysis and risk modeling
- Design, implementation and owner's engineering services
- Grid communications/sensor deployment, data reporting and data governance
- Microgrid, ADMS and DERMS programs
- Physical and cyber security

Physical Security

- Threat and vulnerability assessments
- Building, site and campus security planning
- Security technology engineering and design
- Video surveillance and analytics
- Perimeter security and gunfire detection systems
- Security policy and procedures
- Regulatory compliance audits, implementation and cap analysis
- Training and awareness programs
- Disaster recovery and business continuity planning

IT/OT Solutions

- Technology evaluation and architecture
- Integration roadmaps
- Standards-based adapters for next-gen technologies
- Manages services including financial, programmatic application, infrastructure, integration, help desk, tech refresh and cyber security support

Cybersecurity and Data Protection

- Rapid assessment, evaluation and scorecard development
- Forensics, testing and roadmap planning
- Wired and wireless network scanning and mapping
- Video surveillance and analytics
- Security technology engineering and design
- Information technology and communications infrastructure security
- Security system and process implementation
- Ongoing education and governance

Cloud Solutions

- Consulting, design, implementation and administration services
- Private, public and hybrid cloud systems
- Transition of physical, on-site system to cloud infrastructure

Energy Equity

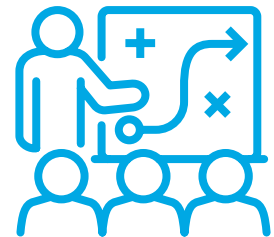
- Back-up power to support vulnerable populations
- Climate action plan design to better serve disadvantaged communities
- Diversity and inclusion plans for client sustainability programs

WORKFORCE DEVELOPMENT



As grid modernization initiatives expand across the electric power system, it is critical to have a utility workforce skilled in the engineering, design and safety concepts and technologies that will control the grid and power assets of the future.

But as an older generation of power engineers and technicians retire at a rapid pace, hiring managers report that lack of training, experience, or technical skills in new candidates are major reasons why replacement personnel can be challenging to find. In today's fast paced, complex market, the window of opportunity to train, reskill and upskill the power workforce has become shorter, creating a significant gap between recent graduates' skills and the practical competencies required by a swiftly changing industry.



As a trusted advisor to the power industry, TRC delivers first-class field solutions through and for a highly trained workforce. Our training programs help utility managers, field engineers and technicians advance their knowledge and skills to safely implement equipment and systems and complete high visibility projects while maintaining reliability. Our engineers and applied learning experts help develop a continuous, systematic and adaptive workforce through a skills-based and professional development curriculum aligned with today's industry needs.

OUR SOLUTIONS INCLUDE:

Aging and Retiring Workforce

- Highly trained engineers and field support team
- Augment your in-house operations
- Support as a direct extension of your own staff
- Skilled and versed in your specific standards and processes

Power Academy Training Program

- State-of the art training center located in Lancaster, PA
- Fully, equipped mock substation supports safe, hands-on experience with testing and commissioning equipment and circuits
- Interactive classroom technologies
- On-site and mobile training, prescriptive or customized
- Courses on testing and commissioning, troubleshooting, policies and procedures, safety, QA/QC, planning, communication and risk reduction
- Program builds technical and professional business skills

Augmented Reality

- Hands-free, heads-up display for remote collaboration and problem solving
- Two-way communication between field and office staff
- Collect, observe, and analyze documents, images and technical drawings
- Virtual expert assistance to reduce errors and more efficiently diagnose and solve critical issues

Human Performance

- Focused training to reduce costly and dangerous substation commissioning errors
- Developed by renowned utility human performance educators
- Helps reduce outage risk
- Helps reduce instances of injury or death



TRCcompanies.com